

IMPORTANT NEW DIS- COVERIES RELATING TO DIGESTION.

BY J. H. KELLOGG, M. D.

Superintendent of the Sanitarium at Battle Creek, Mich., Member of the American Medical Association, Michigan State Medical Society, American Public Health Association, British and American Associations for the Advancement of Science, American Microscopical Society, American Social Science Association, Mississippi Valley Medical Association, Société d'Hygiène of France, British Gynecological Society, and of the International Periodical Gynecological Congress.

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IMPORTANT NEW DISCOVERIES RELATING TO DIGESTION.

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A LENGTHY article appears in a recent number of the *Bacteriological World and Modern Medicine*, giving an extended account of the late remarkable discoveries of Profs. Hayem and Winter, of Paris, two eminent chemists and physiologists, in relation to the work performed by the stomach in the process of digestion. For several years these eminent physicians have been engaged in patient researches in relation to the character of the changes which take place in the food during the digestive process, and they have at last discovered a means by which the digestive process can be studied with a degree of accuracy which secures results hitherto unattained and unattainable. Their method of procedure is to give the patient in the morning, while the stomach is still entirely empty,—neither foods nor fluids having been taken since rising,—a test-meal consisting of two ounces of bread and eight ounces of water. At the end of an hour, a small and very soft and flexible rubber tube is given to the patient, who, placing one end of the tube in the mouth, swallows it into the stomach. By this means a portion of the digestive food is removed from the stomach and submitted to careful chemical tests and minute analysis. The stomach is, as it were, surprised in the midst of its work, and thus the secrets of the digestive process are unlocked, and facts of the greatest value learned.

The new methods of chemical analysis employed by Hayem and Winter enable them to elucidate a number of important questions respecting the digestive process, which have been heretofore only guessed at, no means having previously existed by which accurate information could be obtained. The investigations which have been carried on by them have developed

some very interesting facts in relation to the nature of the work done by the stomach in digestion, which may be briefly stated as follows:—

1. The stomach secretes hydrochloric acid and pepsin. The hydrochloric acid, when secreted, is in combination with chloride of sodium and other bases.

2. Under the vital influence of the stomach activities, the chlorine is set free from the bases with which it is combined, and thus prepared to enter into the work of digestion.

3. By the aid of the pepsin the chlorine is made to combine with the albumen, converting it into peptone, which is absorbed and formed into blood to nourish the body.

It thus appears that there are two different kinds of work done by the stomach: First, the secretion of hydrochloric acid, or chlorine in combination with bases; and second, chemico-vital changes by which the hydrochloric acid is set free and then combined with albumen.

The data obtained by Hayem and Winter render it possible to study with accuracy both the quantity and the quality of the work which the stomach does in both the lines mentioned. Many variations are found possible:—

1. All branches of stomach work may be either increased or diminished.

2. There may be an abundance of chlorine secreted, but no actual digestive work done because the chlorine remains combined with the bases in the form in which it is thrown into the stomach by the gastric glands.

3. There may be a sufficient secretion of chlorine, and an abundance of chlorine set free from the bases with which it is combined, and yet no useful stomach work, for the reason that the chlorine fails to combine with the albumen, the first step in the process by which albumen is changed to peptone and prepared for absorption.

4. There may be too little secretion of chlorine.

5. It is even possible that there may be an abundance of hydrochloric acid secreted, the proper amount of chlorine may be liberated, and there may be also the normal amount of combination of chlorine with albumen, and yet the quality of work done may be of such an inferior character that the individual

will be in a state not far removed from one of actual starvation. It is this class of patients who frequently remark to their physicians, "Doctor, my appetite is insatiable; I could eat all the time and never be satisfied; but my food seems to do me no good; I cannot gain an ounce of flesh, although I eat prodigiously, and I am growing thinner all the time." Such patients are frequently met with, and their cases are often very puzzling, even to physicians.

No class of diseases has given physicians more annoyance than dyspepsia. The cause of the great perplexity in the treatment of this large class of disorders has been the fact that cases presenting identical symptoms are often not relieved by similar methods of treatment, a fact which has led to no little disappointment on the part of both patients and physicians. A remedy which gives most satisfactory results in a single case, or even in a series of cases, proves to be equally unsatisfactory in another case apparently identical, and perhaps gives only a succession of dismal failures in cases to which it seems to be exactly adapted. The methods of studying the gastric fluid devised by Profs. Hayem and Winter, fortunately offer a means of relief from this perpetual uncertainty, and have opened the way for the rational treatment of a vast number of cases which have heretofore been subjected, for the most part unavoidably, to a blind and most disappointing empiricism.

The writer became acquainted with the methods referred to, by notices in the Paris journals of the work of these eminent physicians, and secured, as soon as published, the little volume giving a full description of their methods, entitled "*Chemisme Stomacal*." After some months' careful study of the subject, and trial of the methods described, they have been put in full operation in the Laboratory of Hygiene connected with the Sanitarium, at Battle Creek, Mich., and most interesting practical results are every day realized by their employment. Several hundred analyses have been made, and the light which they throw on the cases investigated, has been such as could not have been obtained from any other source.

This is not the proper place for a publication of technical details nor histories of cases, but it is important that it should be known that a wonderful advance has been made in rational

medicine ; that another vast domain of disease, which has heretofore been almost wholly unexplored, in consequence of the lack of precise and accurate means of investigation, has been conquered by science, and that the well-trained physician has now placed in his hands a means by which he can, if he chooses, bring out from their obscurity a vast number of cases which have hitherto been exasperatingly puzzling and baffling, even to the wisest and most experienced of medical men.

It is also interesting to note that the results of these recent investigations bring into strong light the value of hygienic methods in the treatment of digestive disorders. Diet and regimen are found to be of vastly greater value than medicinal agents of any sort, although medicinal agents of an appropriate character are by no means of small value in the management of a certain class of cases. Elaborate investigations, especially with reference to the causes and best means of cure of digestive disorders, are in progress in the Laboratory of Hygiene connected with the Sanitarium, and the results, which are already interesting, will be made public in due time.

Not the least interesting feature of the new method of studying disorders of the stomach, is the fact that the precise data obtained by the methods employed, render it possible to place upon a mathematical basis and express in formulæ by the aid of symbols, every kind and degree of disturbance in the normal digestive process. The data obtained, and the symbols used to represent the various quantities determined by analysis, are as follows :—

1. The total acidity, represented by A.
2. The total amount of chlorine secreted by the stomach, represented by T.
3. The amount of free hydrochloric acid present in a given stomach fluid, represented by H.
4. The amount of chlorine combined with albumen, or combined with chlorine, which indicates the useful work done by the stomach, represented by C.

As secreted, the chlorine has no acid properties, being combined with bases. When set free in the form of hydrochloric acid or combined with albumen, values which are represented by H and C, it exhibits strongly acid properties.

The total acidity of the gastric juice is practically the result of the combined values of H and C; in other words, $H + C = A$. From this formula we derive, by simple algebraic methods,

$$A - H = C, \text{ and also } \frac{A - H}{C} = 1. \text{ Having obtained by analysis}$$

the quantities which are represented by A, H, and C, and substituting these quantities for the symbols in the last formula, it is sometimes found that the result obtained is more than 1, and sometimes less than 1. It is evident that if the result obtained exceeds 1, it is because the total acidity, A, contains acid substances which are not furnished by H or C. These acids are the result of acid fermentation, consequently this formula furnishes a means of determining not only the presence but also the amount of acid fermentation, which cannot be determined by any other known means. Another formula will illustrate this: Representing the acids of fermentation by x , the formula for a case in which acid fermentation was known to be present, would be $A = H + C + x$, from which we have $A - H = C + x$, and

$$\frac{A - H}{C} = 1 + \frac{x}{C}.$$

We have found the value of $1 + x$ in some cases to be as high as 6, which indicates that the amount of acidity due to acid fermentation is six times the normal element represented by C. The value of this fact will be estimated when it is realized that the methods of treatment necessary for the relief of excessive acidity of the stomach due to acid fermentation, and that due to an excessive secretion or liberation of hydrochloric acid, are precisely opposite in character. The value of the method referred to in this article will also be appreciated when it is understood that it is the only means heretofore afforded by science for the determination of this important question.

Another fact of almost equal consequence is furnished by this simple formula. If the working out of the formula, after substituting for the symbols the figures obtained by the analysis, gives a result less than 1, or to be exact, less than .86, which has been determined by observations upon healthy individuals, it is clear that the value of C, expressed by the figures, and

which should represent the useful stomach work, is really a fictitious one; in other words, C is at a discount and not worth its face value. This has been found to be the result of the formation of abnormal products in the stomach, which, although affording the usual amount of chlorine and hence giving a normal value to C, as determined by analysis, were of no use in nutrition. It is not an uncommon thing to find the

value of $\frac{A-H}{C}$ to be nothing, instead of 1, which means that

the stomach, although perhaps doing as much work as a healthy stomach ought to do, is doing no useful work at all, the products of digestion being utterly devoid of value. This sort of patients eat abundantly, and yet are starved.

Normal digestion is represented in the new method by the following formula:—

$$A = a = T = \frac{H}{C} = \left. \right\} =.$$

A case of excessive stomach work, or hyperpepsia, is expressed by the formula:—

$$A + a + T + \frac{H}{C} = \left. \right\} +.$$

In a case in which there is too little stomach work, or hypo-pepsia, the formula is:—

$$A - a - T - \frac{H}{C} = \left. \right\} -.$$

These different formulæ combine themselves in a great variety of ways in the expression of the various modifications of the digestive process met with in disease.

This subject, which may be called the algebra of the stomach, when thoroughly mastered, renders the study and treatment of cases of dyspepsia—heretofore rather a dull and uninteresting subject to the physician, as well as a tedious and distressing one to the patient—a most interesting and even fascinating line of investigation. New combinations and varieties of deviation from the normal type are constantly met with, and peculiar and unexpected results are brought to light by the mathematical calculations and the working out of formulæ in each case.